FIG. 1

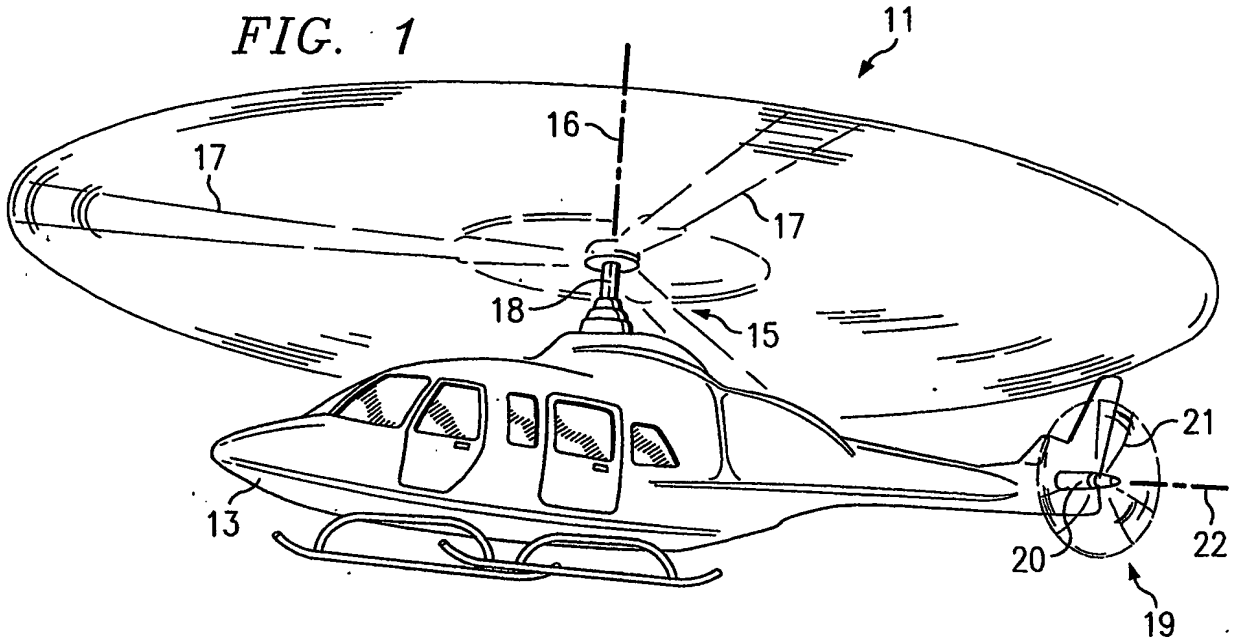
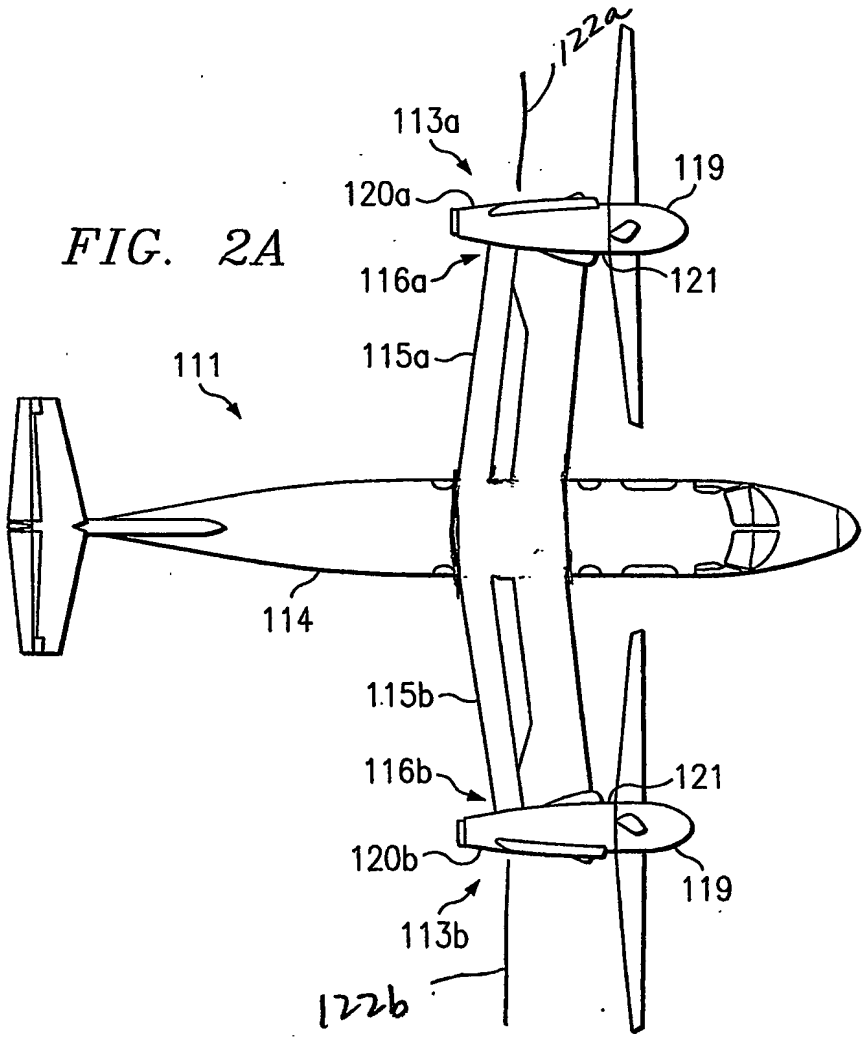

11
16
17
17
18
15
21
13
22
20
19

FIG. 2A


122a
113a
119
120a
116a
121
115a
111
114
115b
116b
121
120b
119
113b
122b

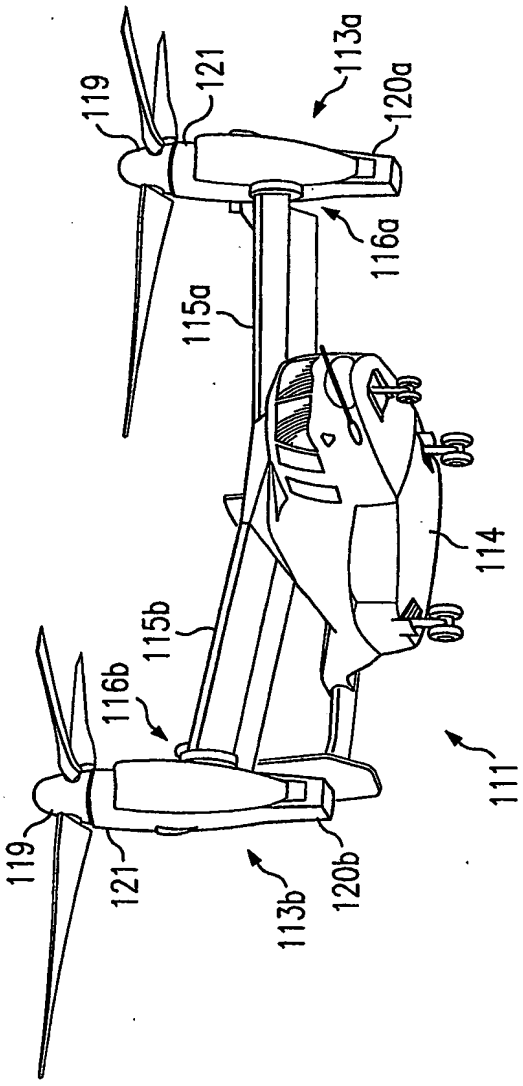

119
121
113a
120a
116a
115a
115b
116b
114
111
119
121
113b
120b

FIG. 2B

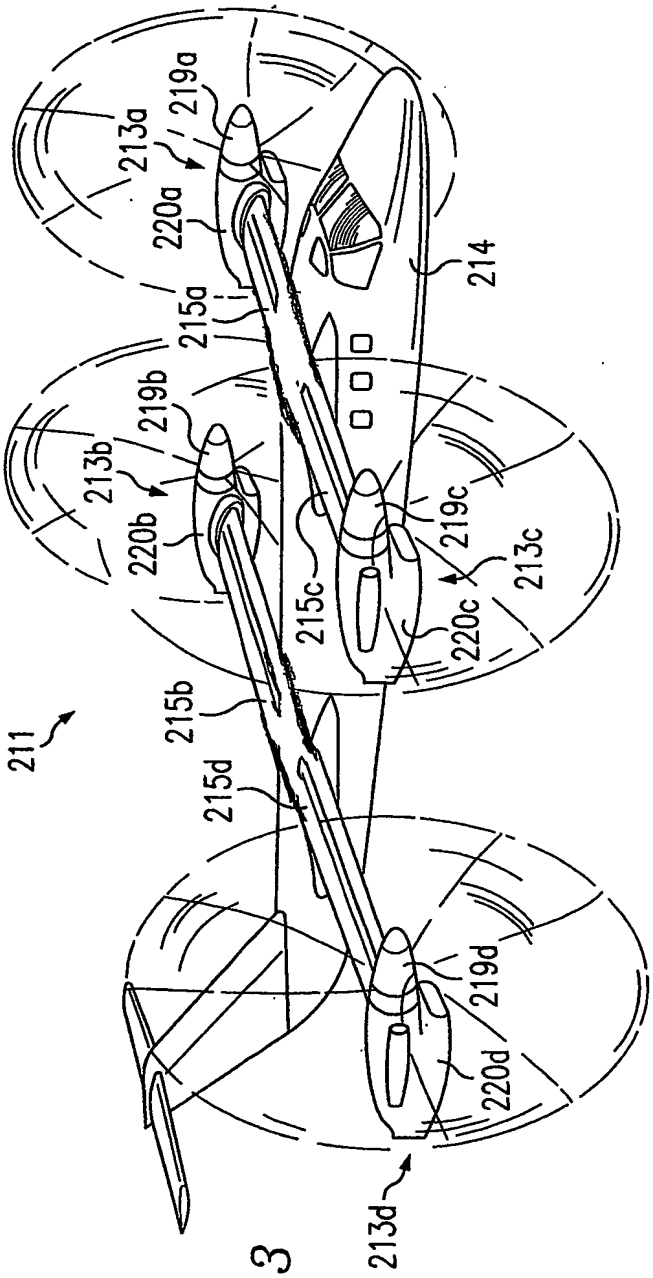

213a
219a
220a
214
215a
219b
213b
220b
219c
213c
215c
220c
215b
211
215d
219d
220d
213d

FIG. 3

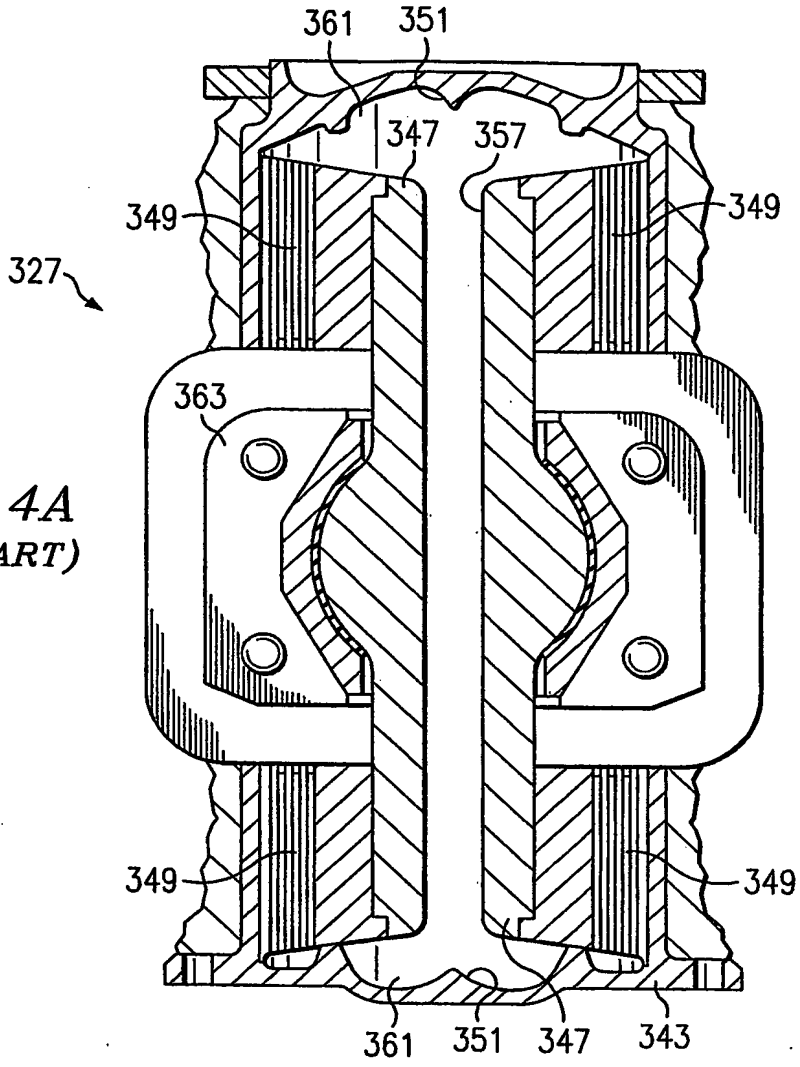


FIG. 4A
(PRIOR ART)

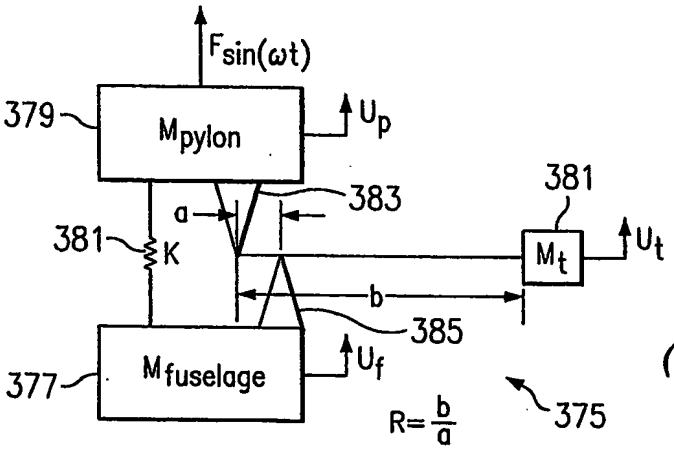


FIG. 4B
(PRIOR ART)

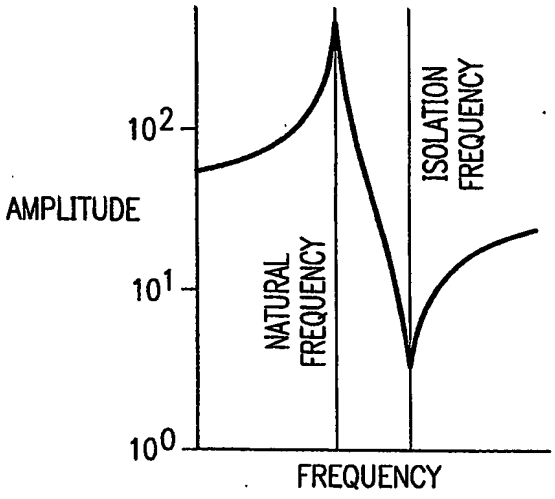


FIG. 4C
(PRIOR ART)

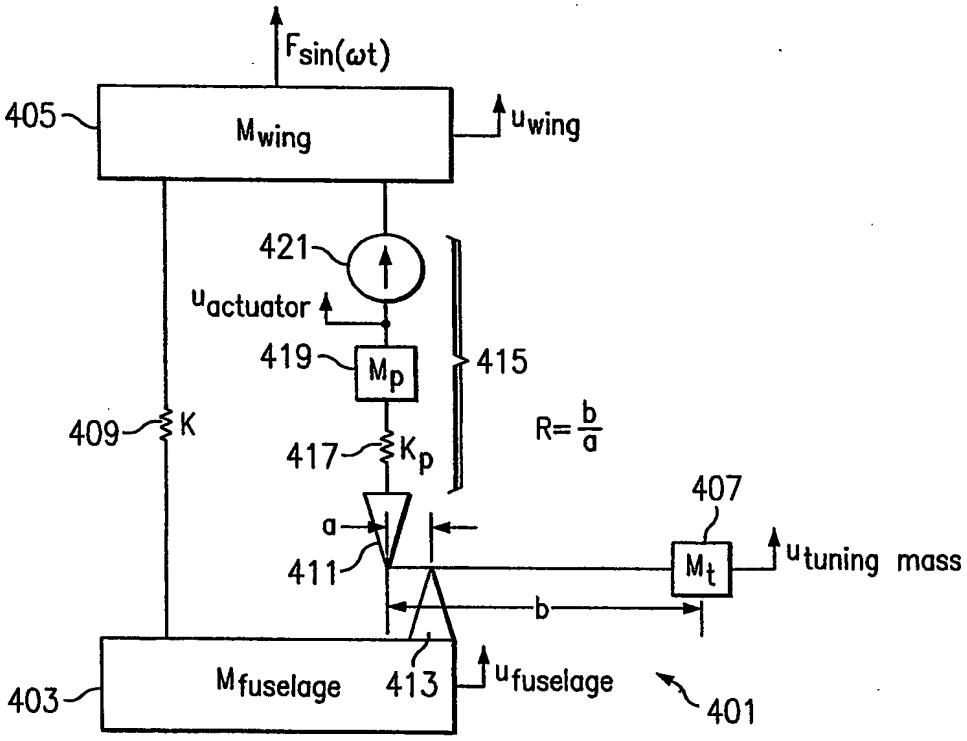


FIG. 5A

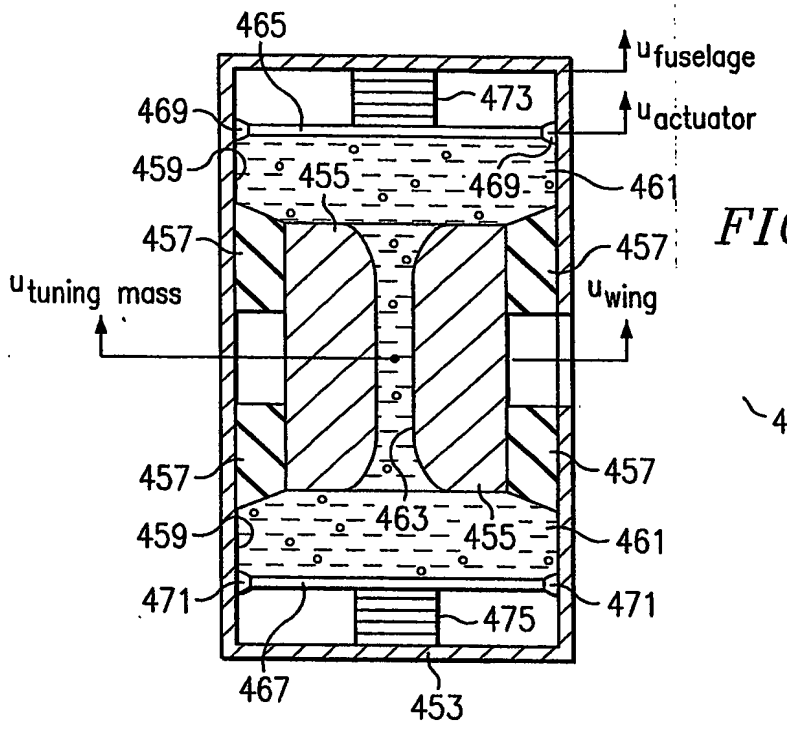

465
$u_{fuselage}$
473
$u_{actuator}$
469
459
455
469
461
457
457
$u_{tuning\ mass}$
u_{wing}
451
457
457
463
459
455
461
471
471
475
467
453

FIG. 5B

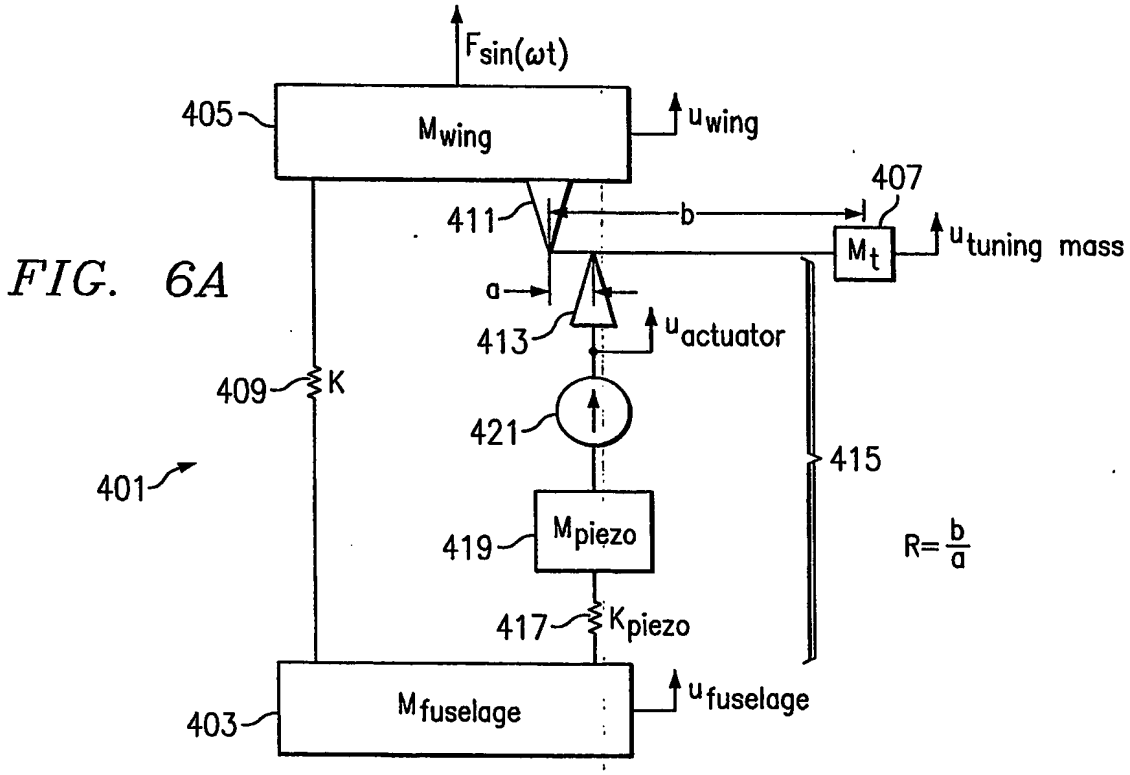

$F\sin(\omega t)$
405
M_{wing}
u_{wing}
407
411
b
M_t
$u_{tuning\ mass}$
a
413
$u_{actuator}$
409
K
421
415
401
419
M_{piezo}
$R=\frac{b}{a}$
417
K_{piezo}
403
$M_{fuselage}$
$u_{fuselage}$

FIG. 6A

FIG. 6B

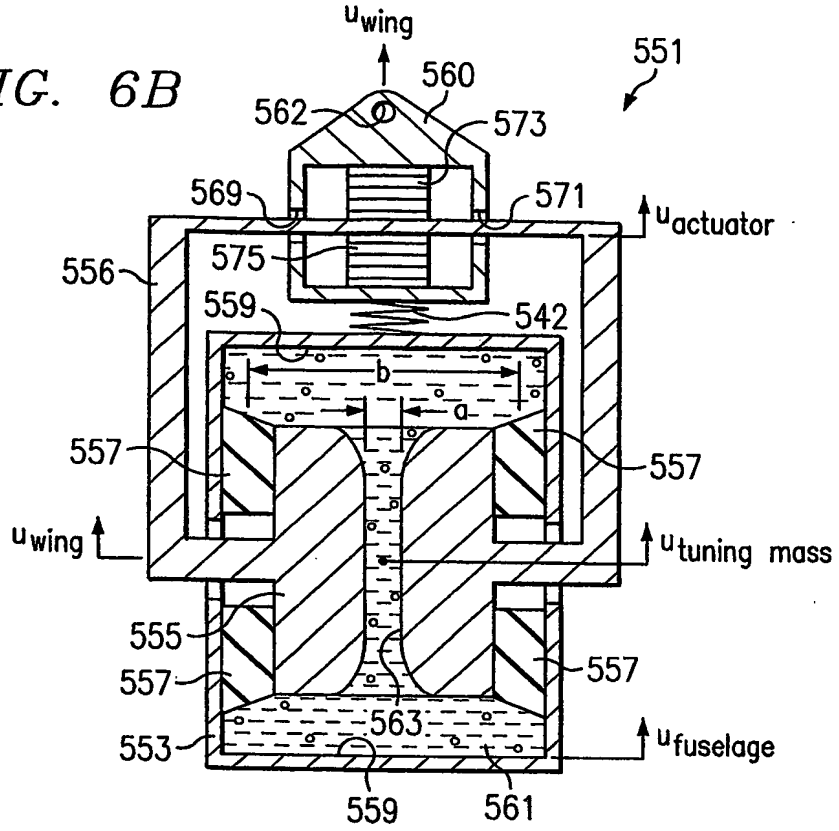


FIG. 7A

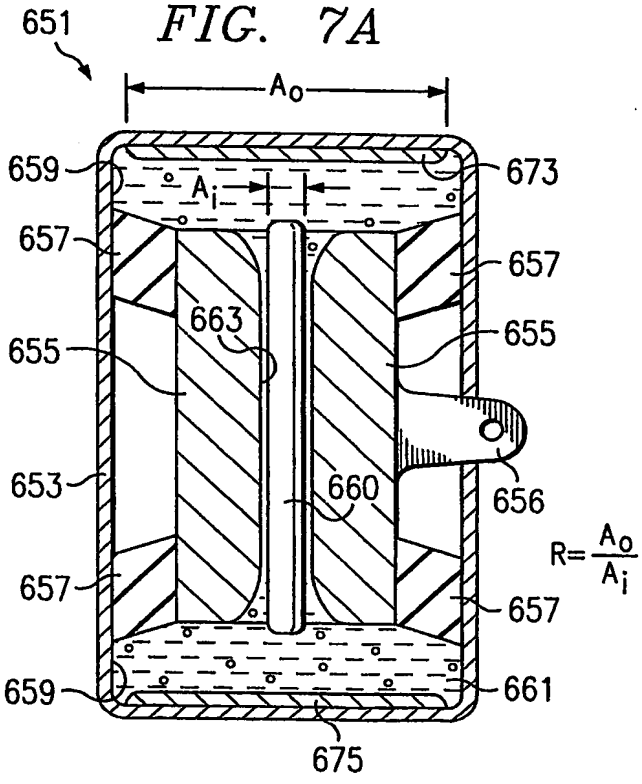


FIG. 7B

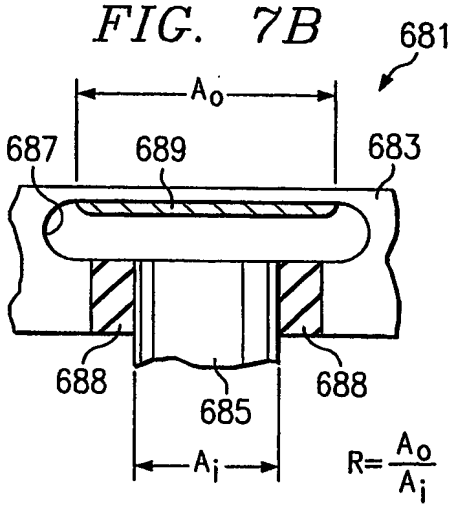


FIG. 7C

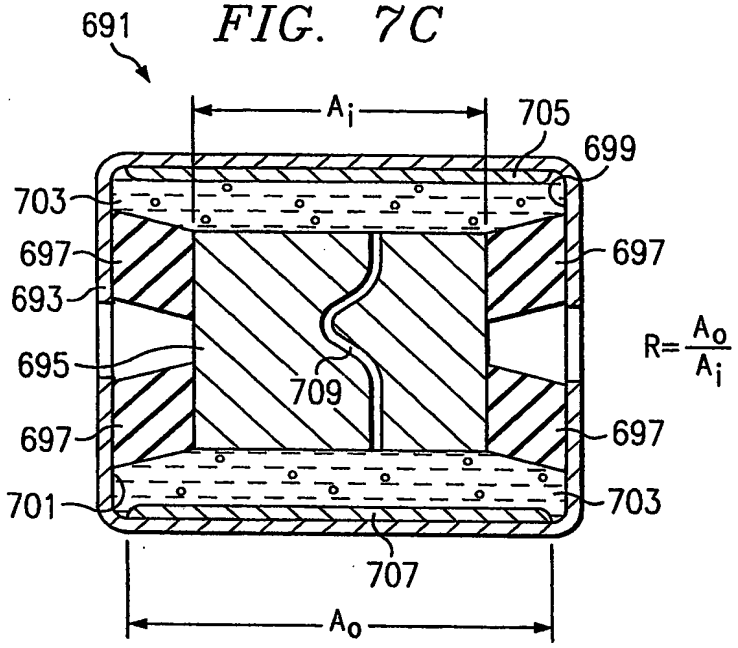

691
A_i
705
699
703
697
697
693
695
709
697
697
701
703
707
A_o
$R=\frac{A_o}{A_i}$

FIG. 7D

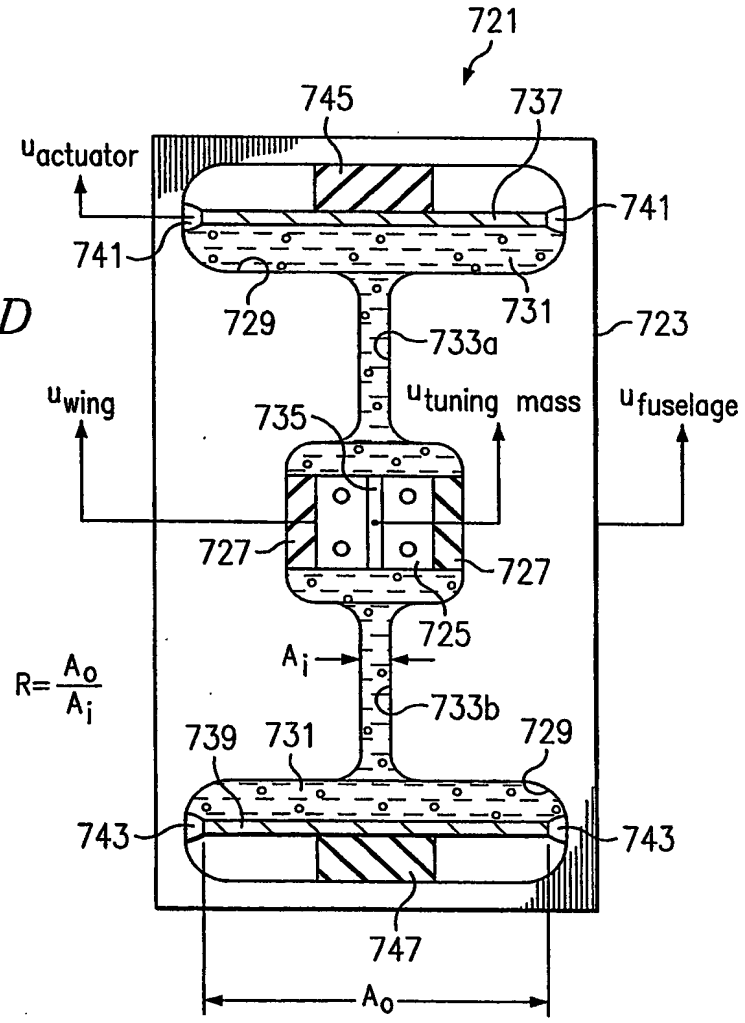

721
745
737
$u_{actuator}$
741
741
729
731
723
733a
u_{wing}
735
$u_{tuning\ mass}$
$u_{fuselage}$
727
727
725
A_i
$R=\frac{A_o}{A_i}$
733b
739
731
729
743
743
747
A_o

FIG. 8

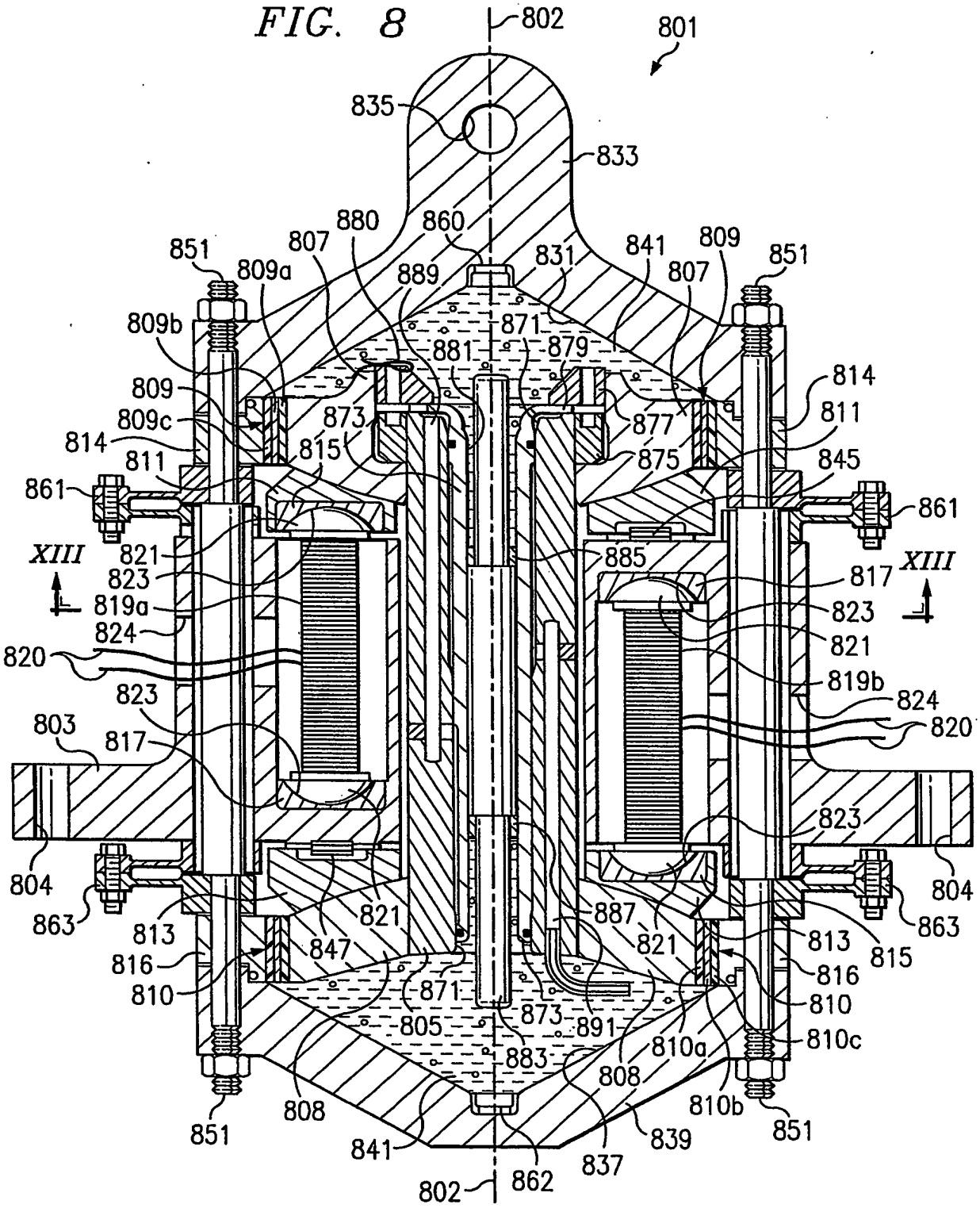

802
801
835
833
851
809a
880
860
807
889
831
841
809
807
851
809b
871
881
879
809
814
811
809c
873
877
814
815
875
845
811
861
861
XIII
821
885
817
XIII
823
819a
823
824
821
820
819b
824
823
820
803
817
823
804
804
863
821
887
863
813
847
821
813
815
816
816
871
810
873
810
805
891
810a
810c
883
808
808
810b
851
851
841
839
837
862
802

FIG. 9

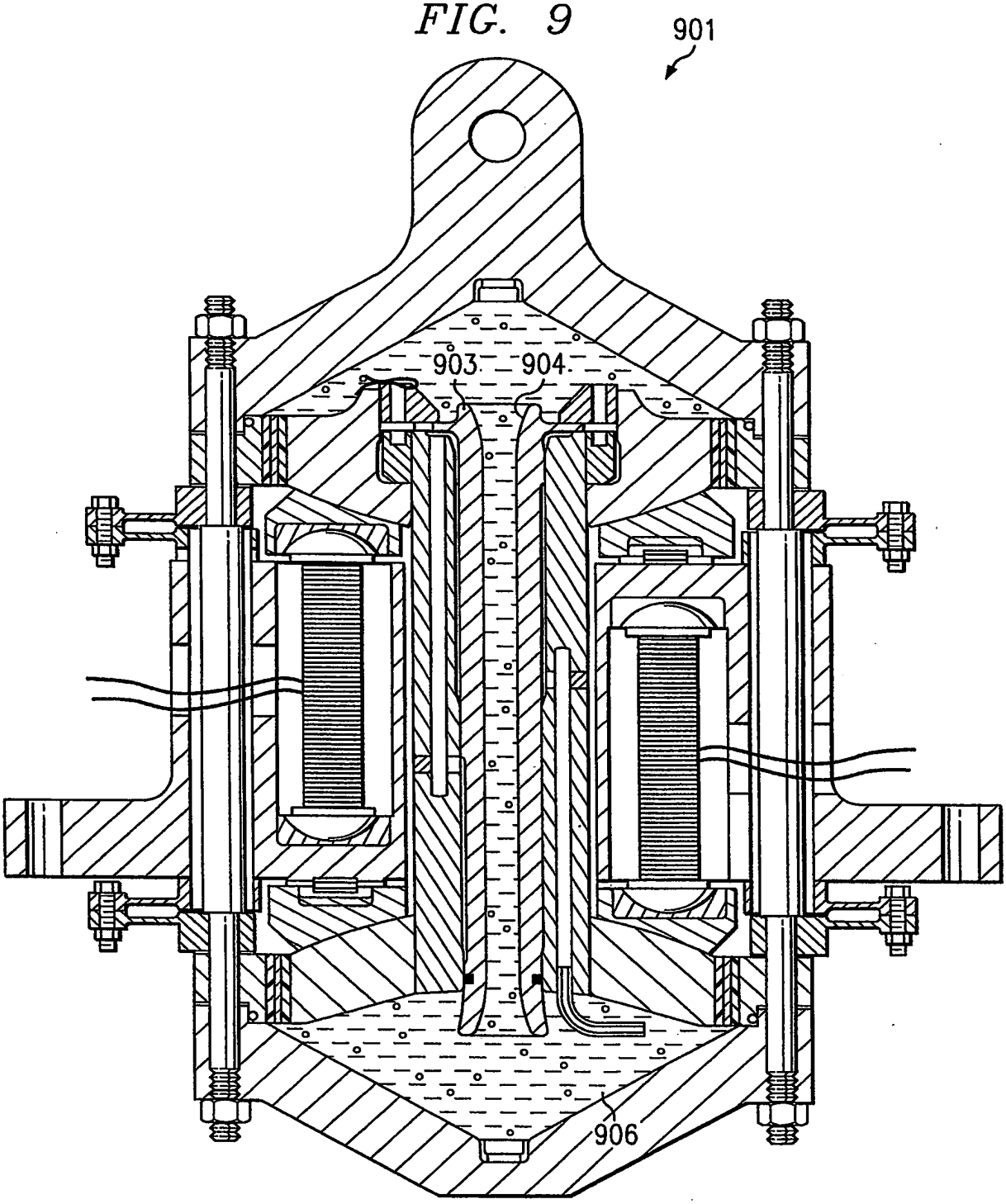


FIG. 10

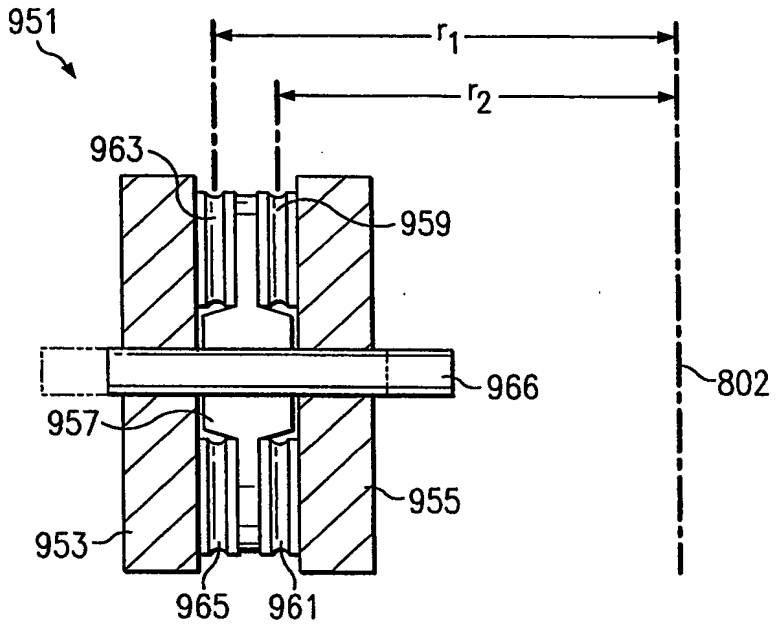


FIG. 11

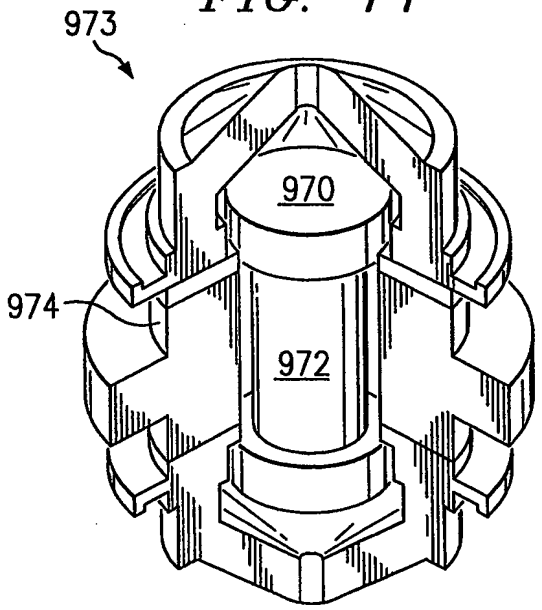


FIG. 12

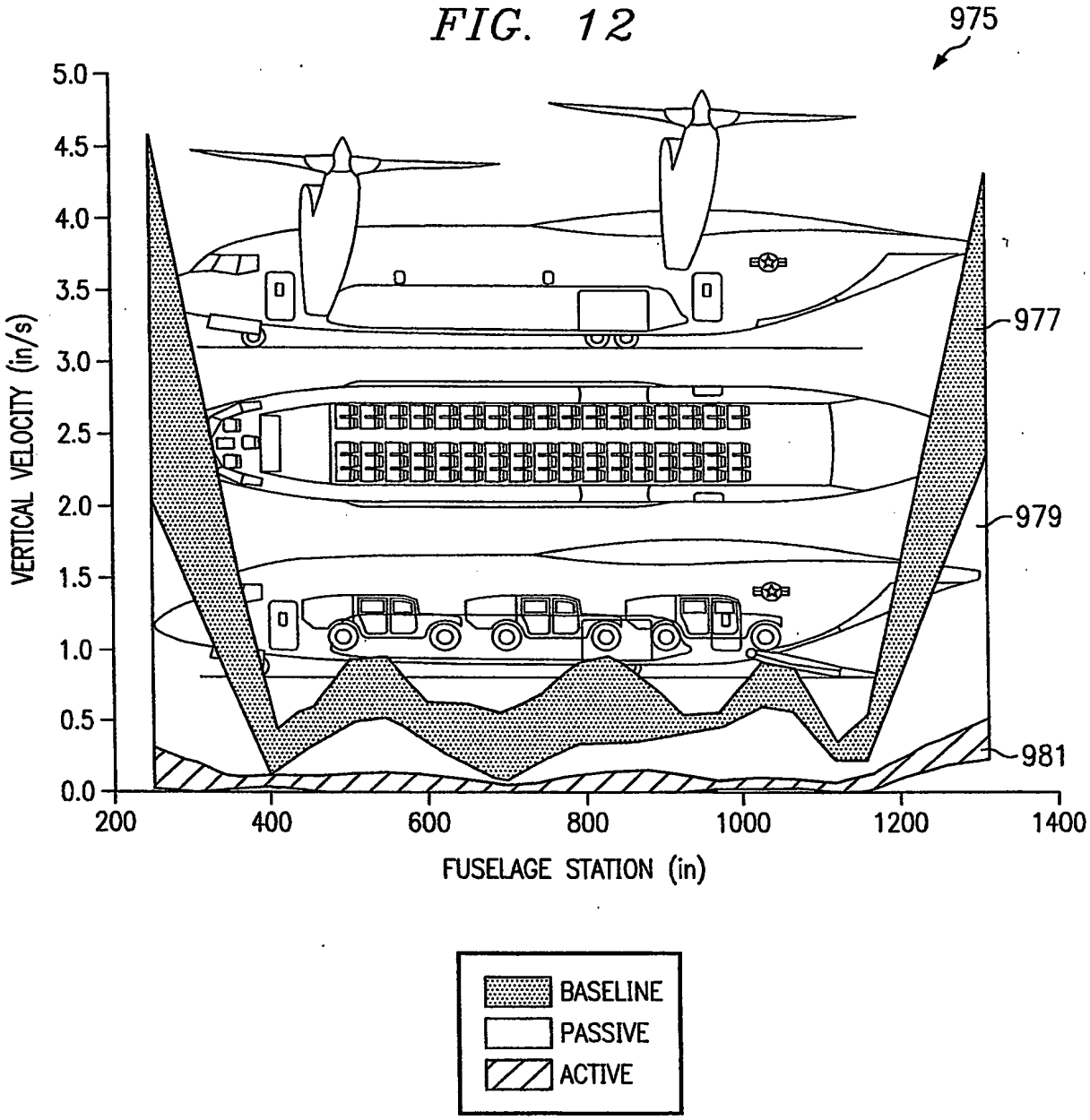

975
977
979
981
VERTICAL VELOCITY (in/s)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
200
400
600
800
1000
1200
1400
FUSELAGE STATION (in)
BASELINE
PASSIVE
ACTIVE

FIG. 13

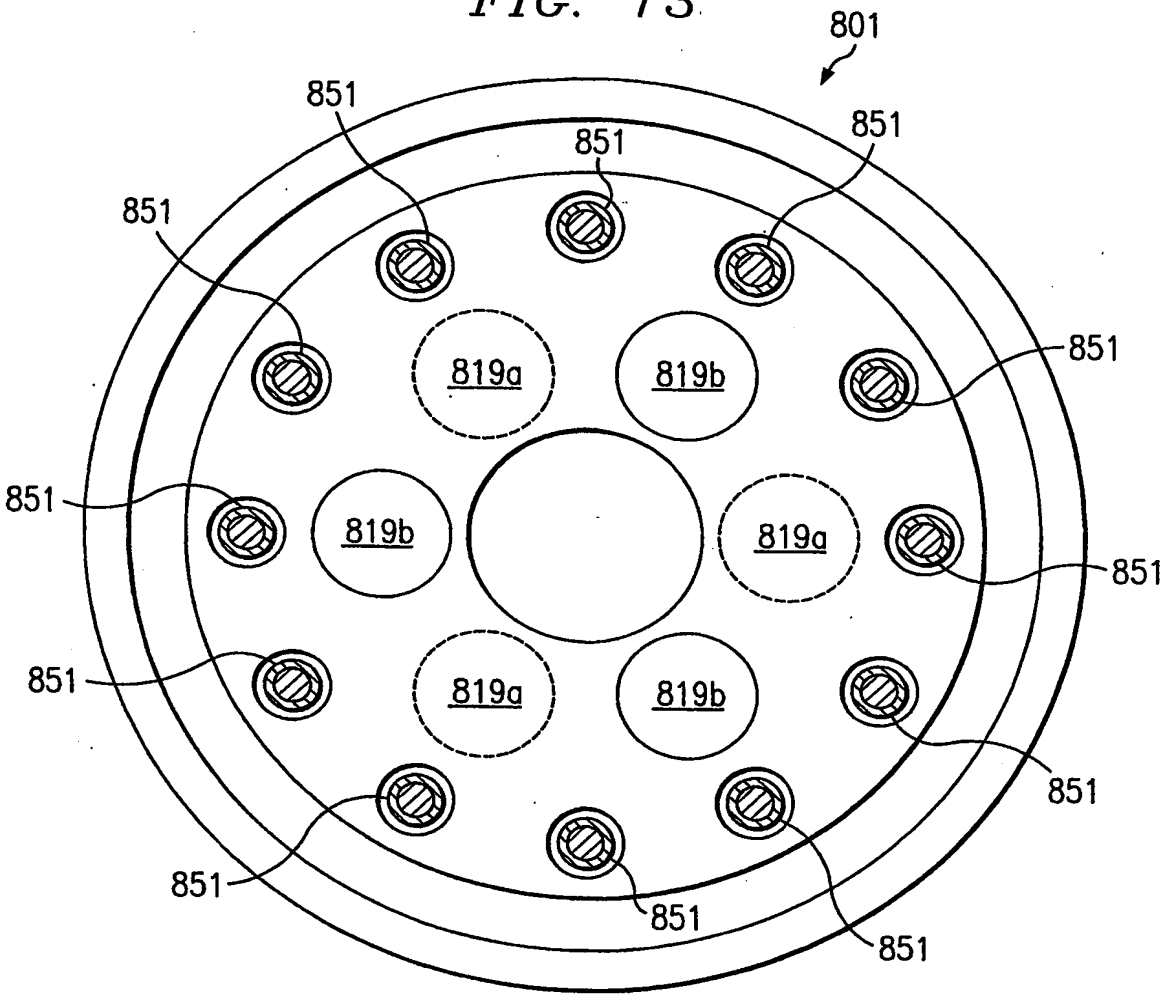
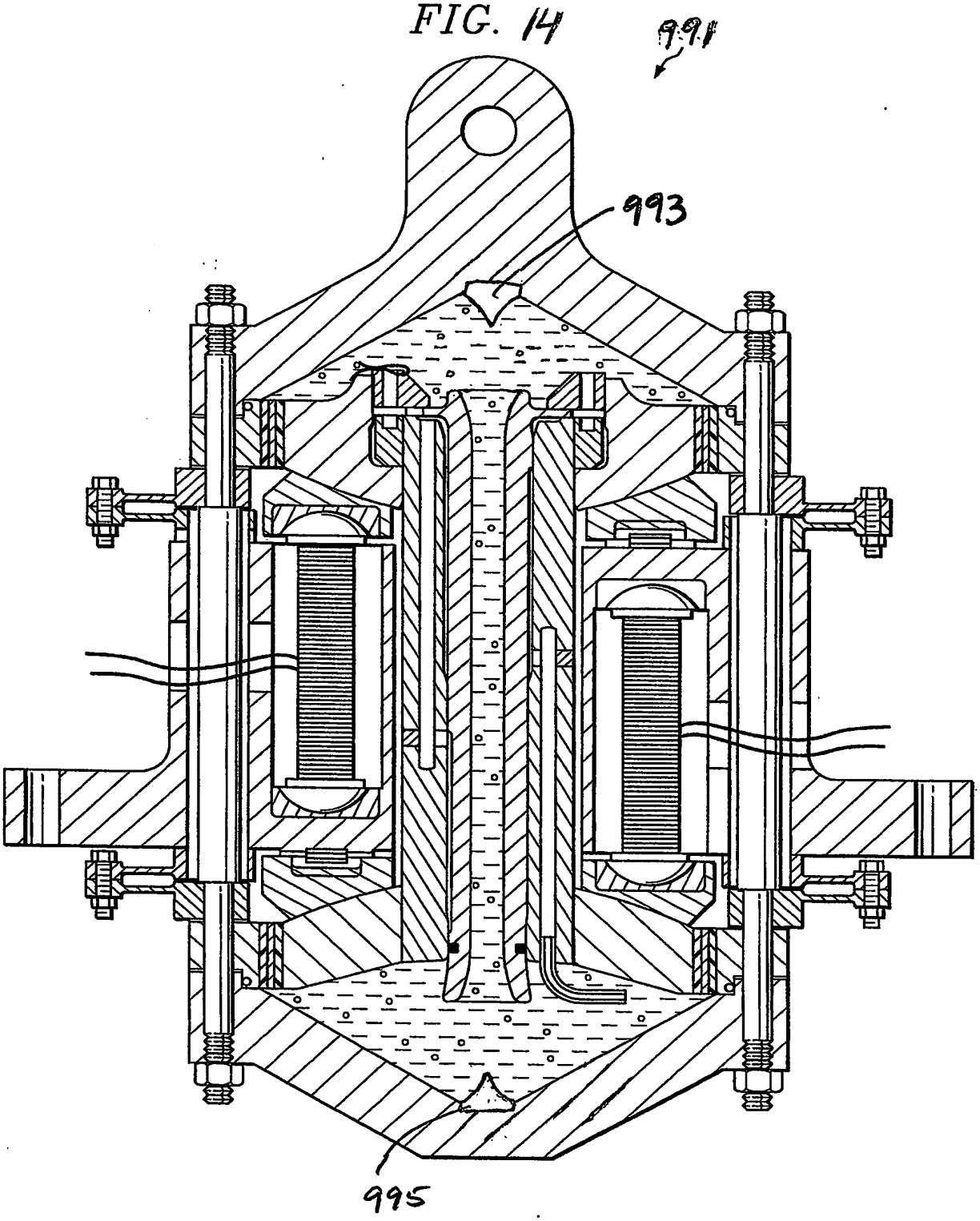

801
851
851
851
851
851
851
851
851
851
851
851
851
851
819a
819b
819b
819a
819a
819b

FIG. 14



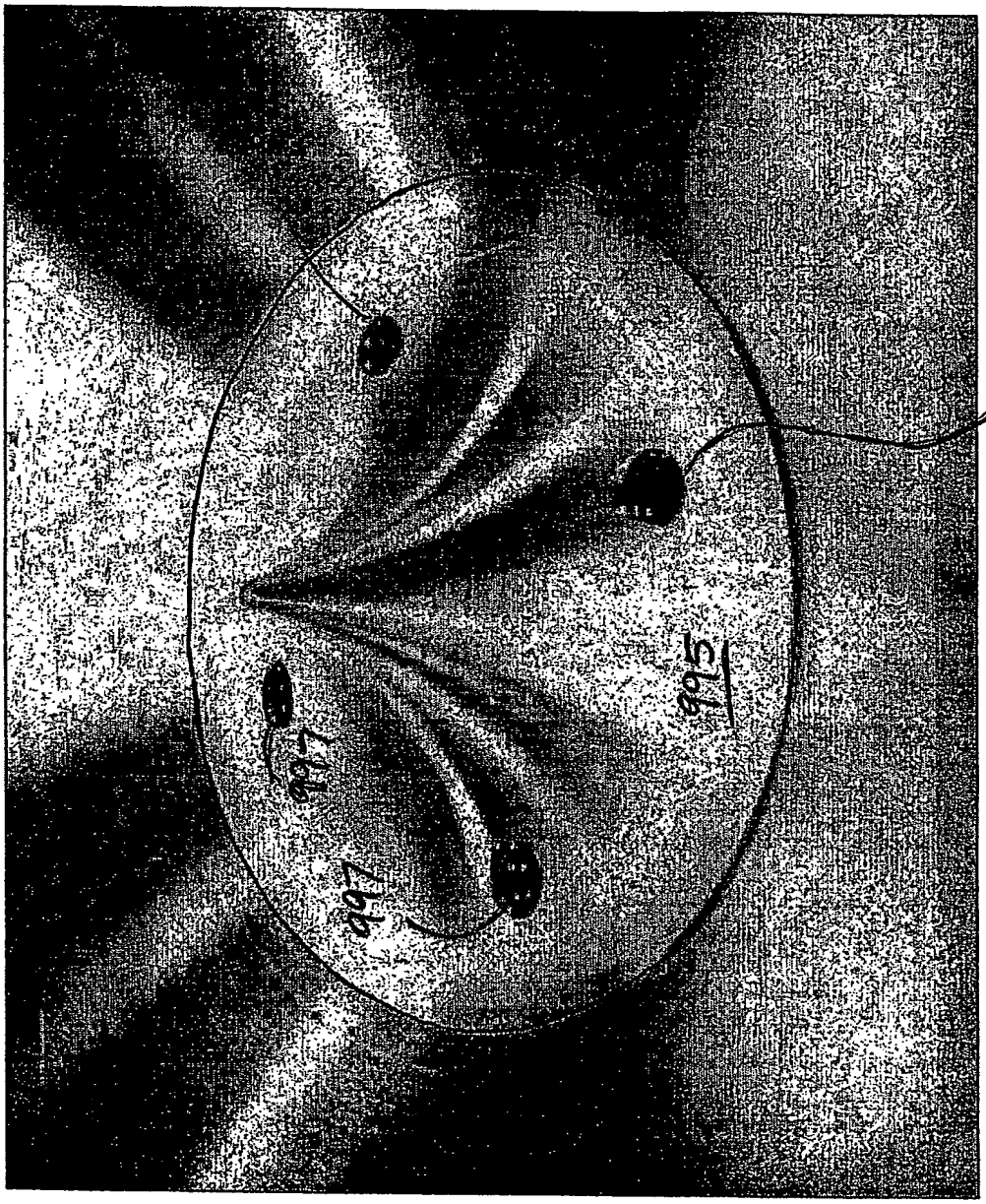


Fig. 15

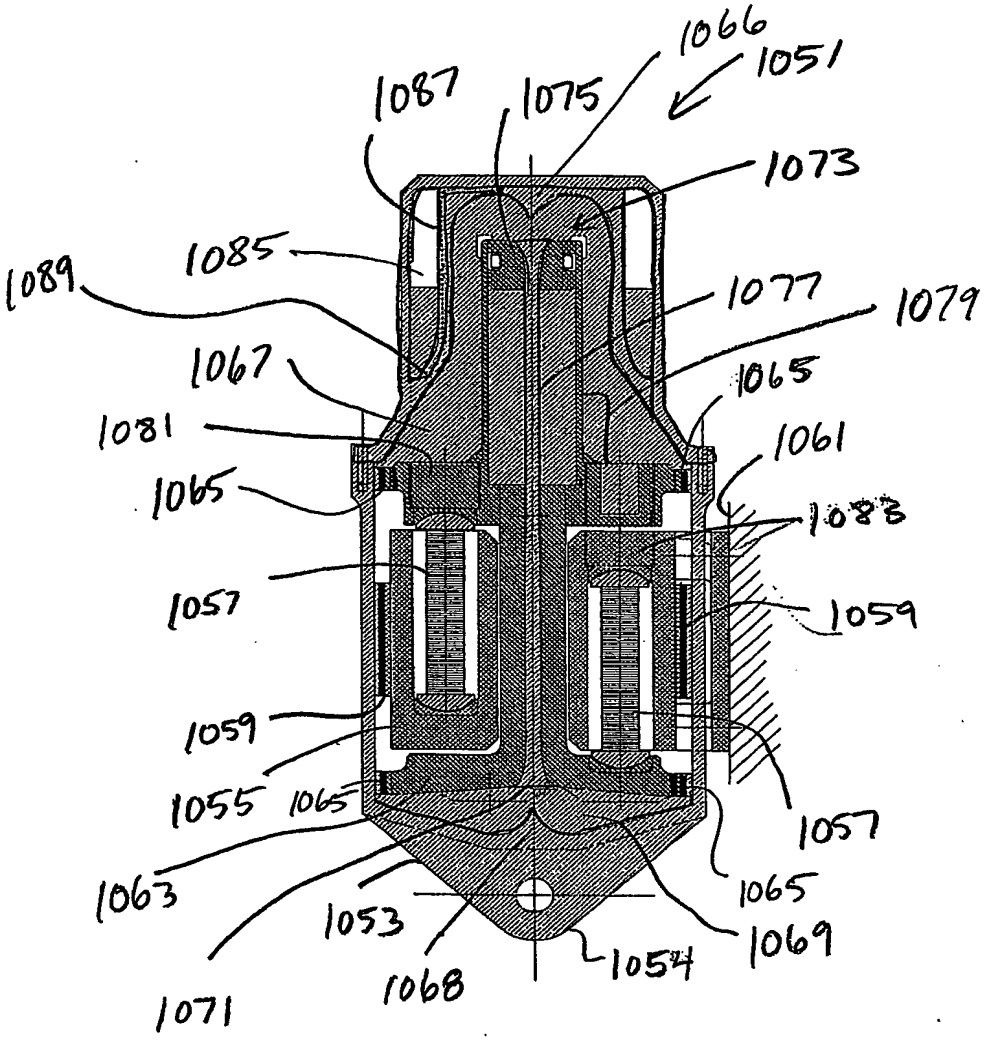


Fig. 16

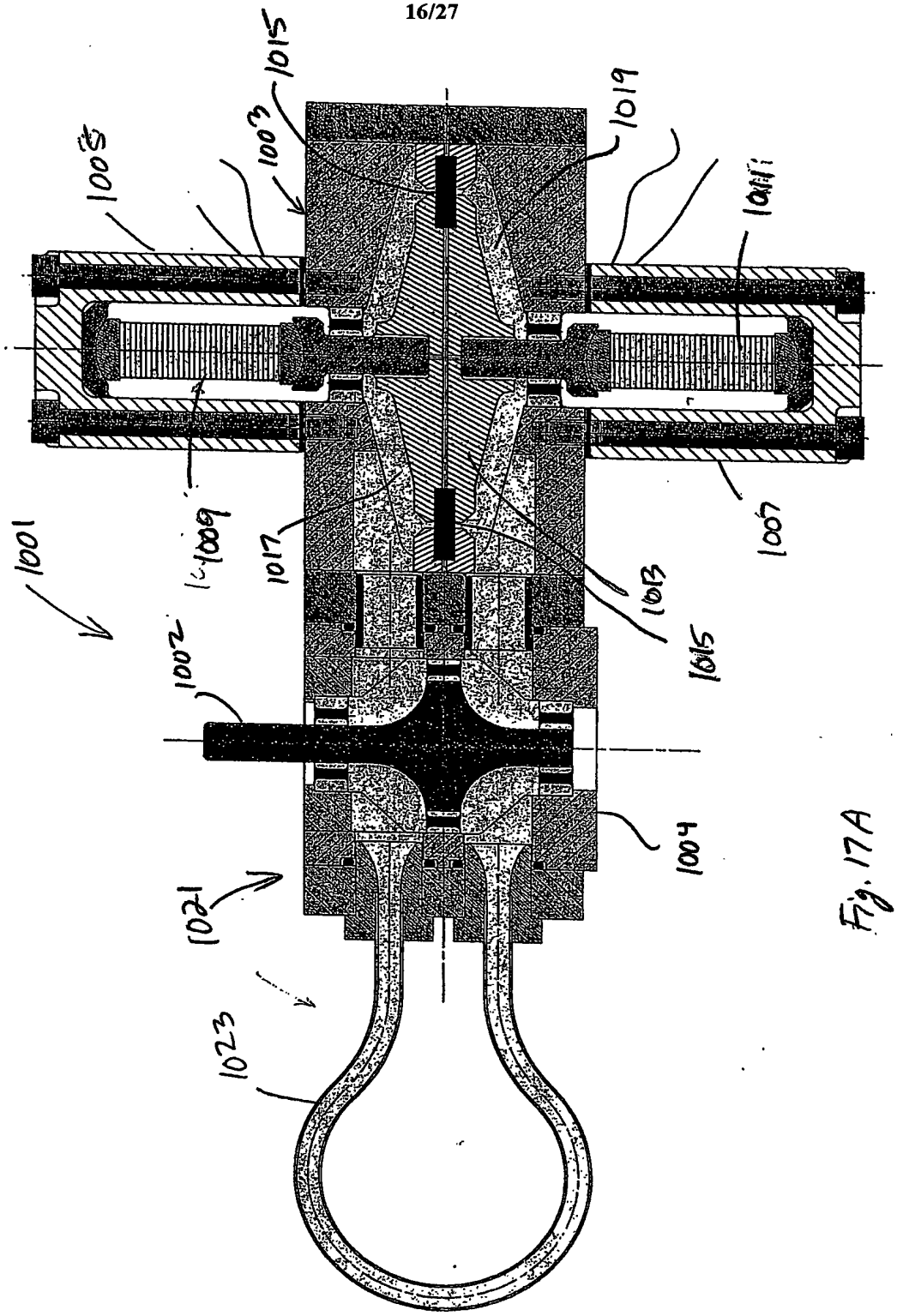


Fig. 17A

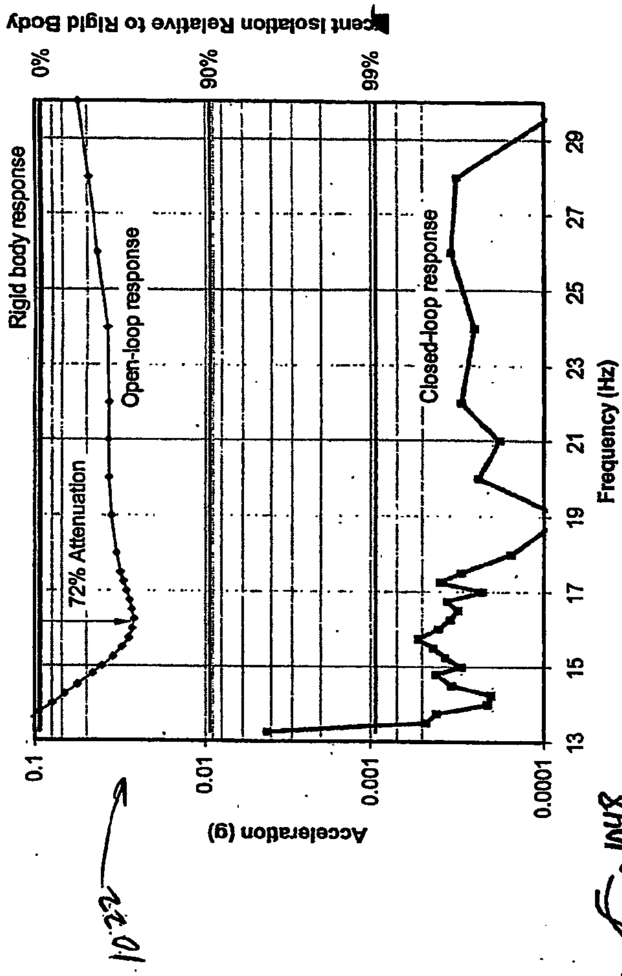


Fig. 17B

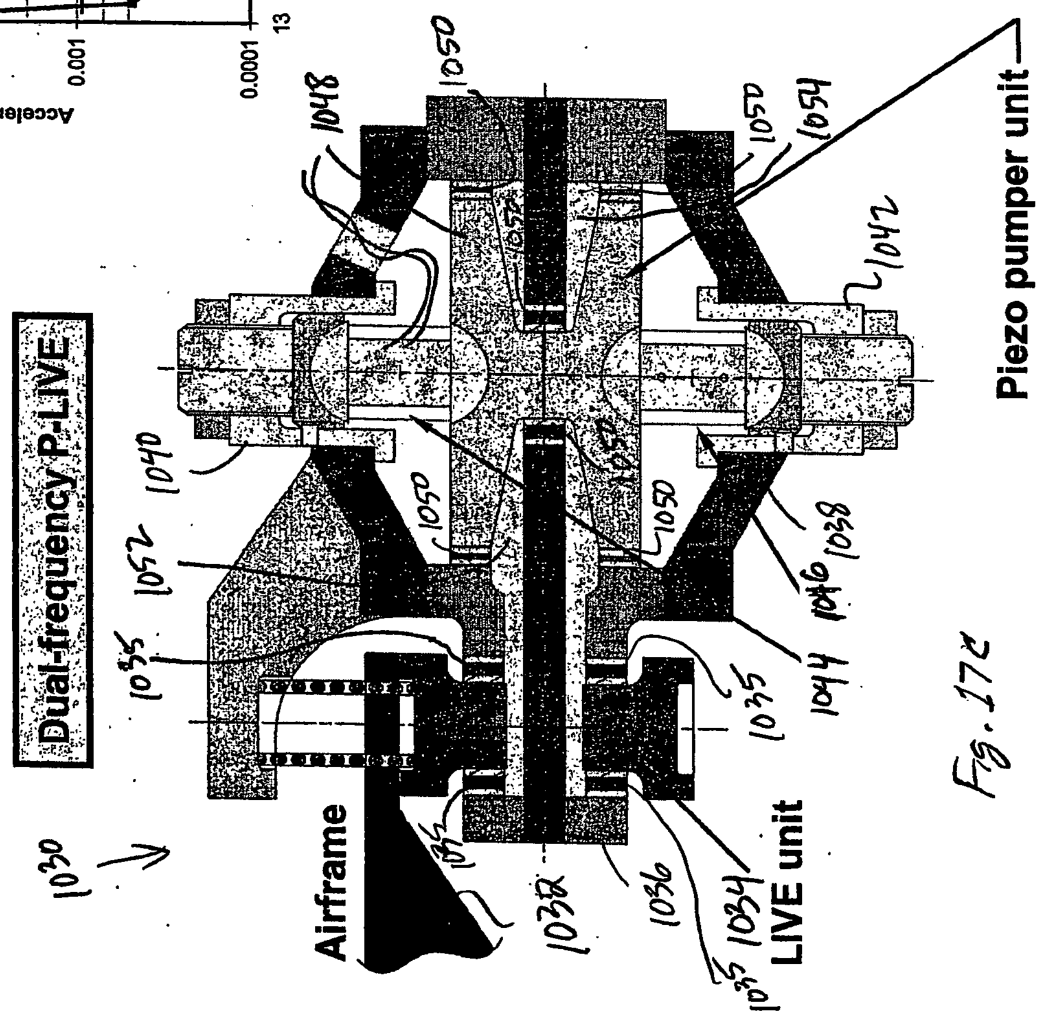


Fig. 17C

Governing Equation for isolation frequency

$$f_{isolation} = \frac{1}{2\pi}\sqrt{\frac{4K\eta g}{R_{LIVE}(R_{LIVE}-1)\pi d_t^{\,2} l_t \rho_t}}$$

Fig. 19A

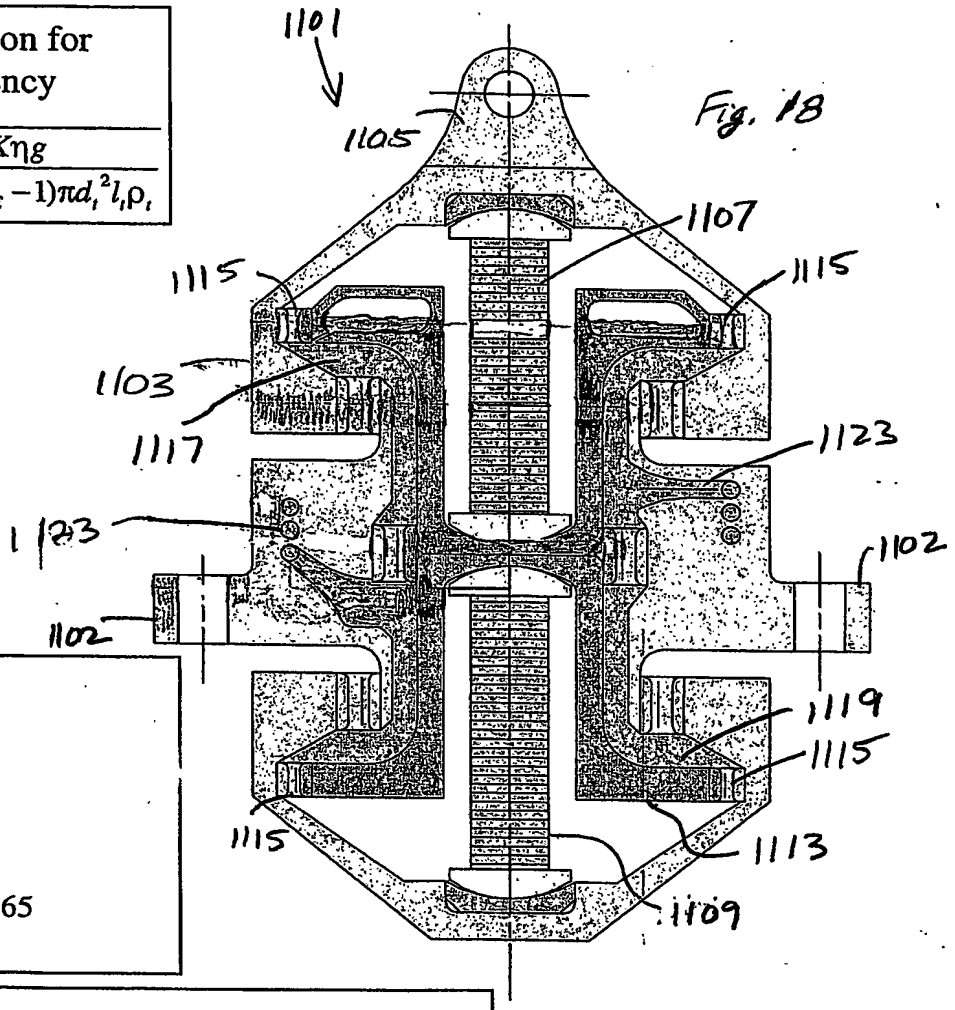


Fig. 18

Fig. 19B

Area ratios

$$R_{piezo} = \frac{(2.1884)^2}{(1.1447)^2} = 3.65$$

Length and number of turns of fluid tuning passage

$$l_t = \frac{4K\eta g}{R_{LIVE}(R_{LIVE}-1)\pi d_t^{\,2}\rho_t(2\pi f_{isolation})^2}$$

$$N = \frac{l_t}{2\pi r_t}$$

Fig 19C

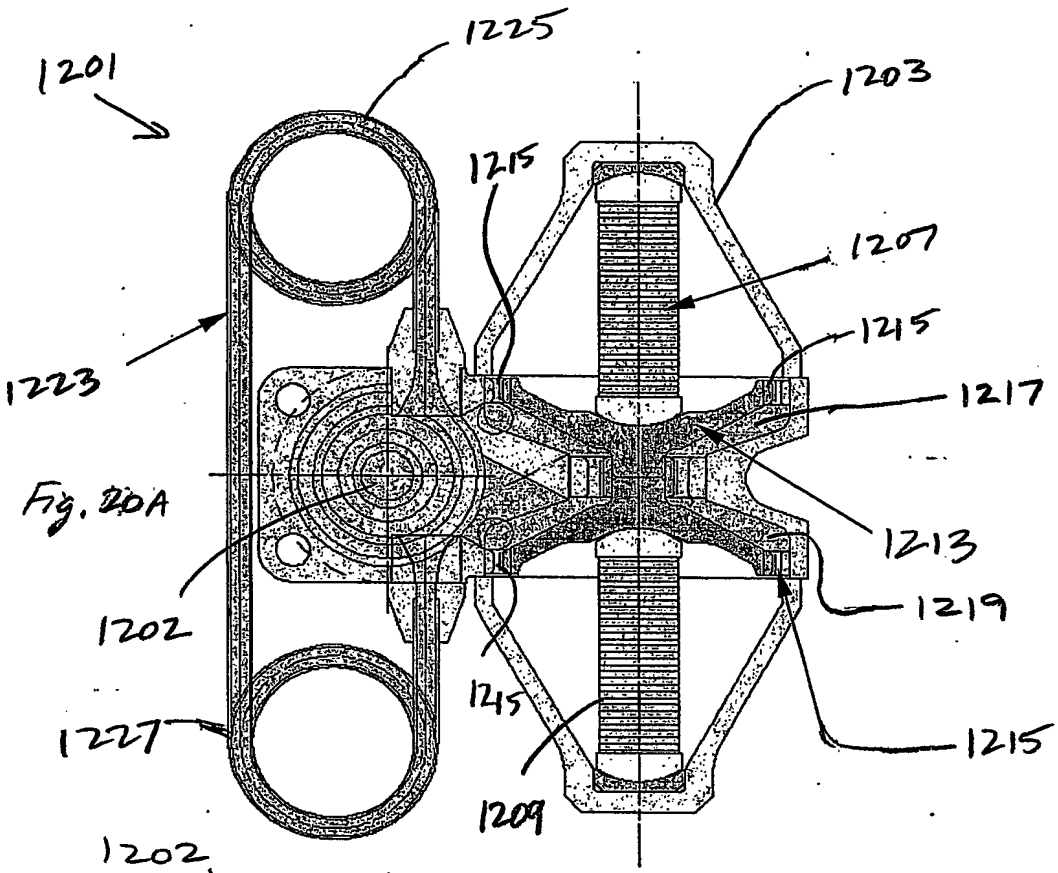


Fig. 20A

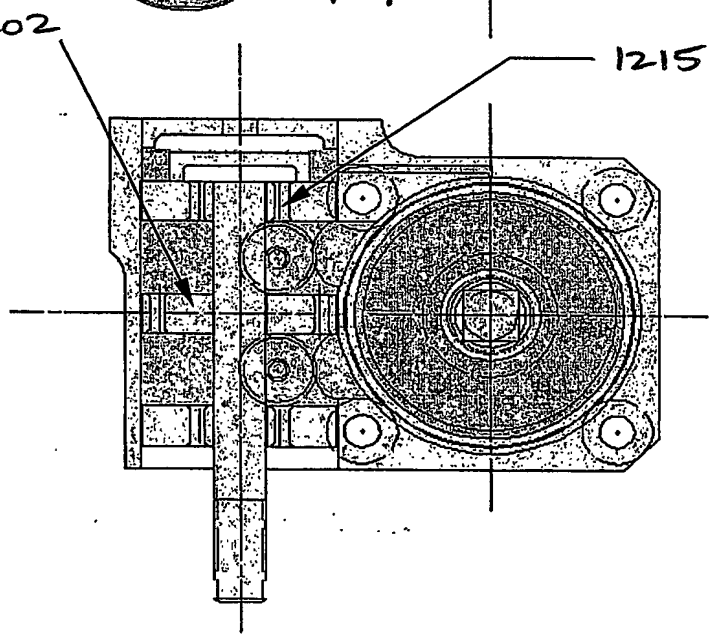


Fig 20B

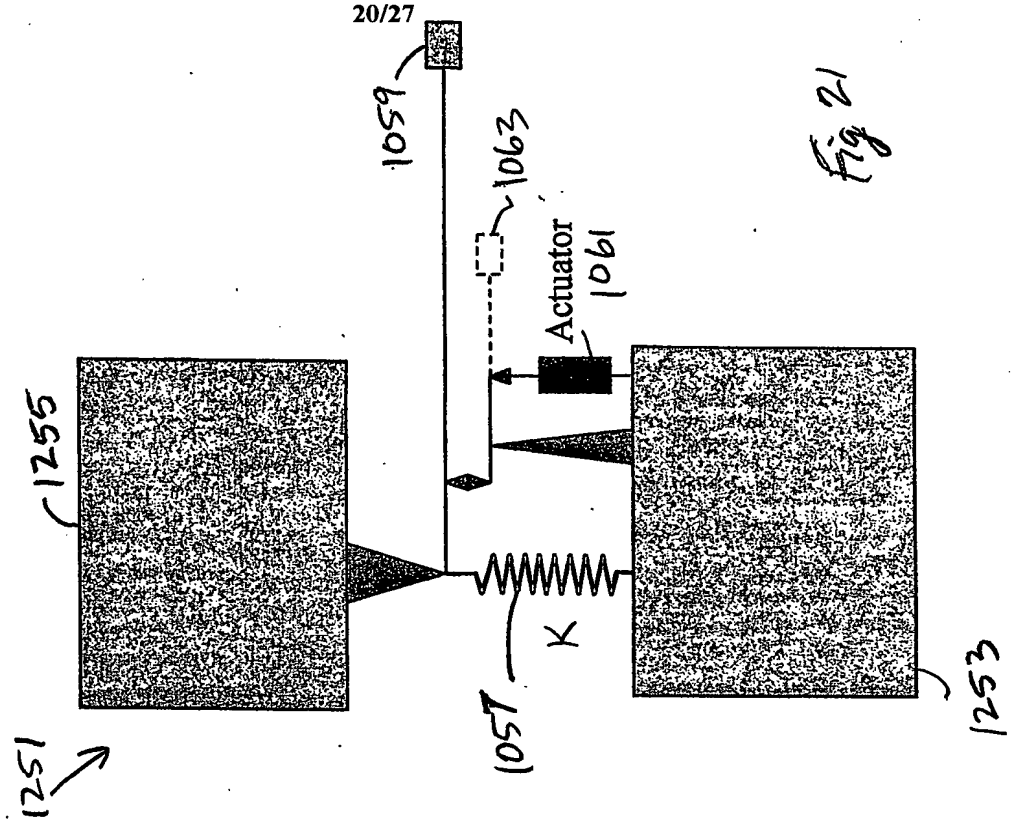


Fig 21

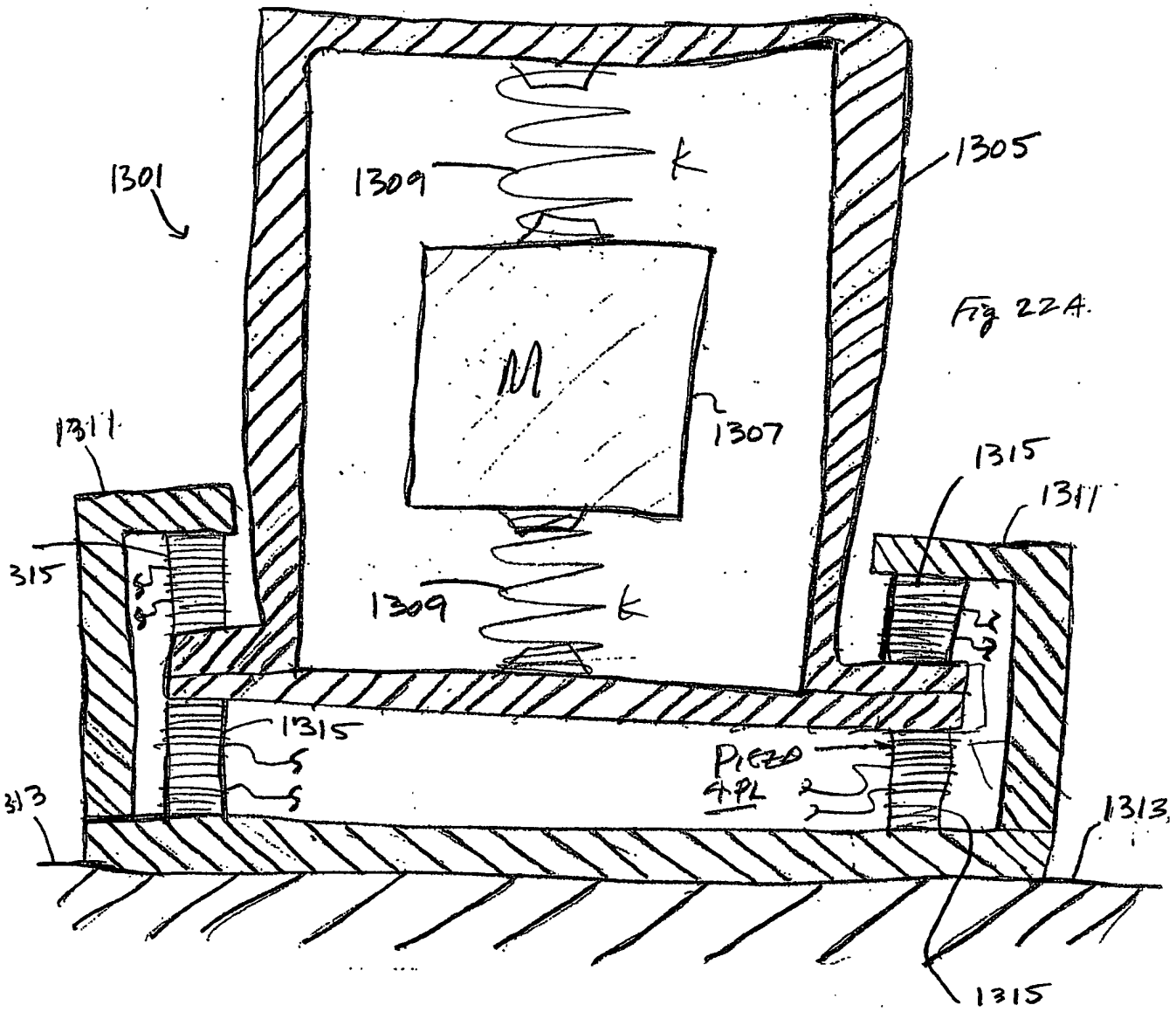


Fig 22A.

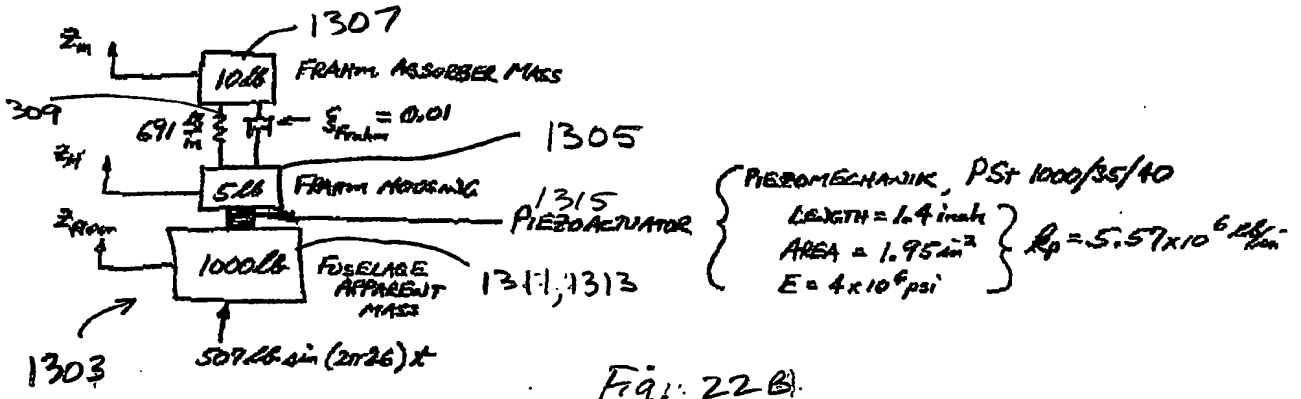


Fig. 22B.

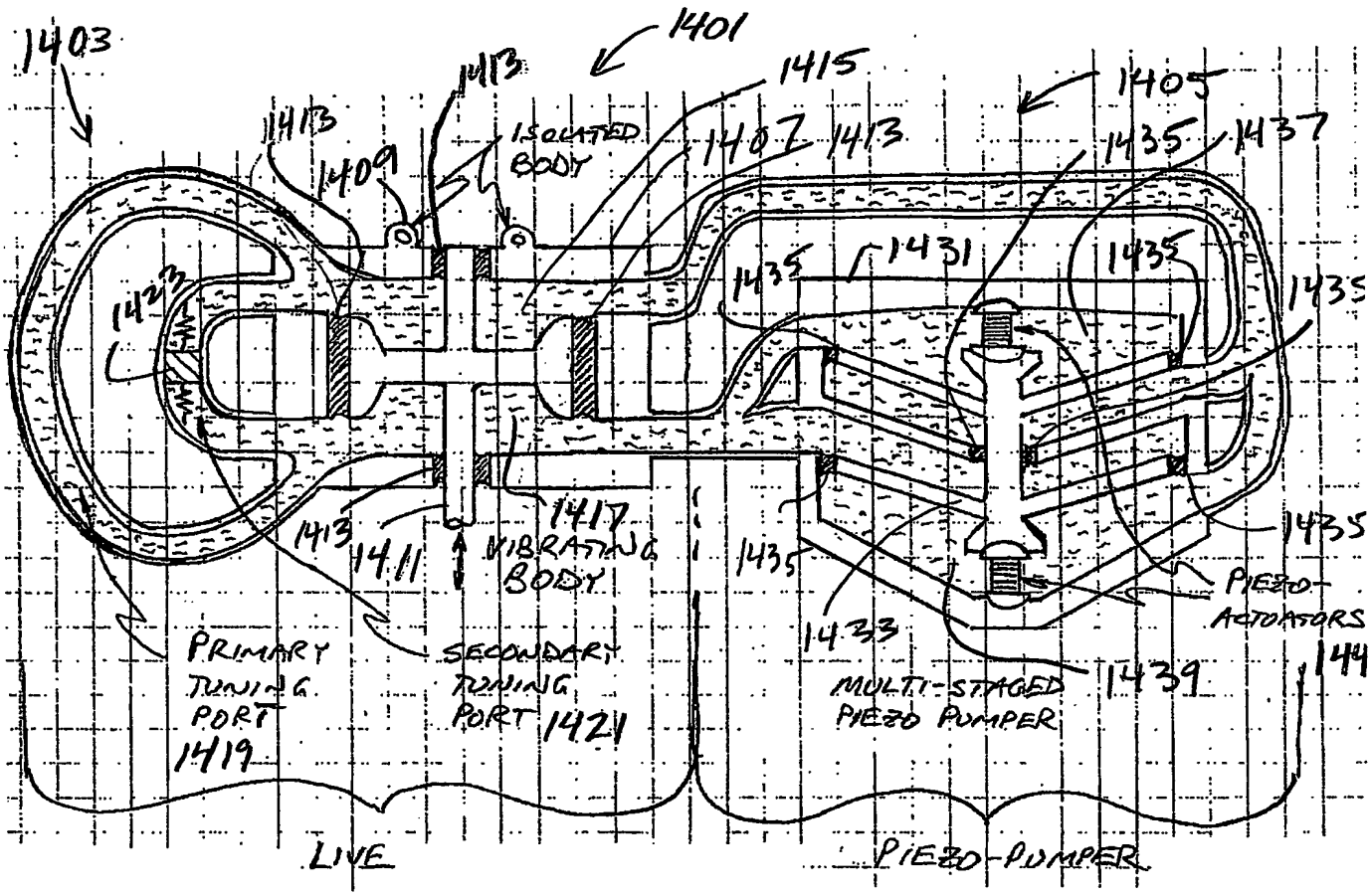


Fig. 23A

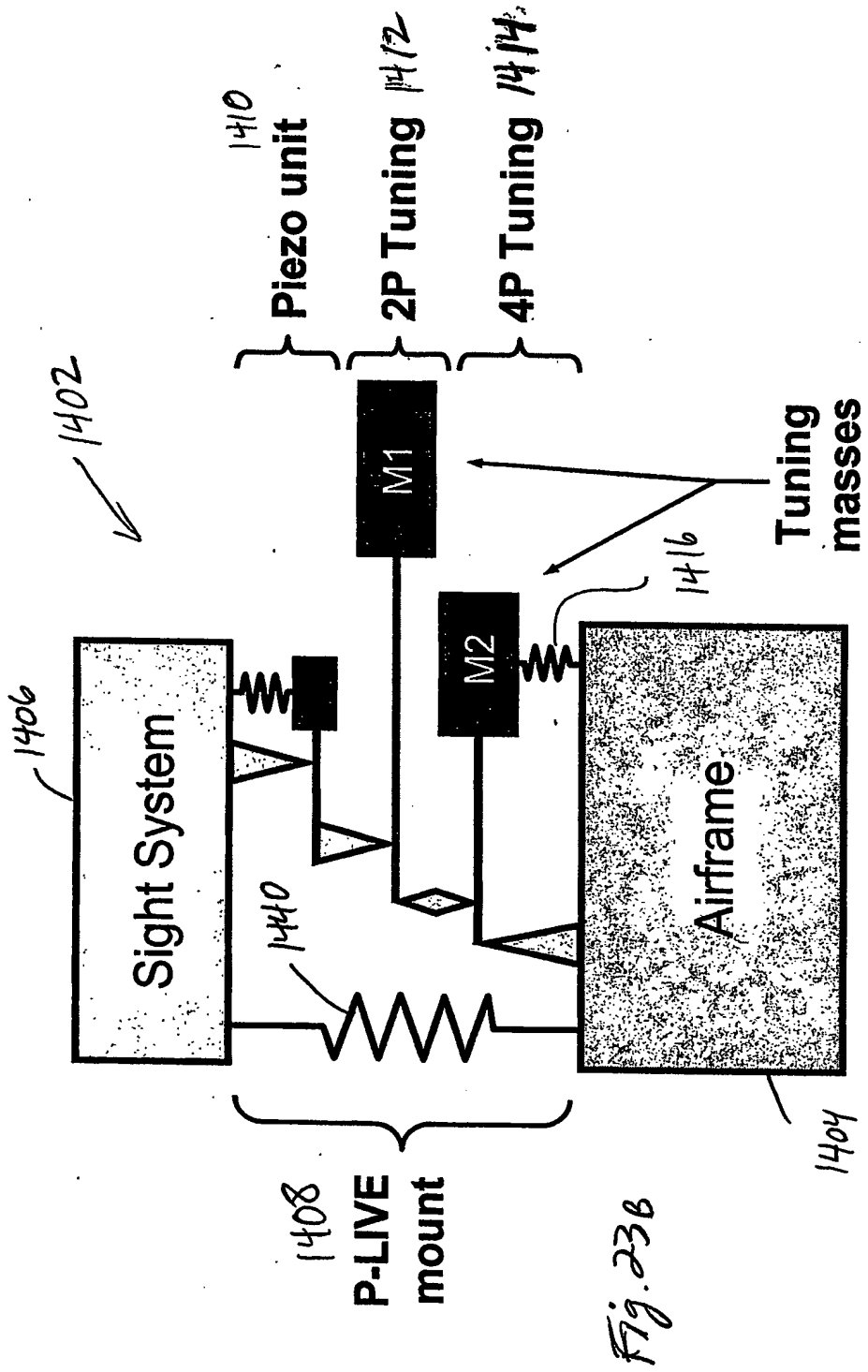


Fig. 23B

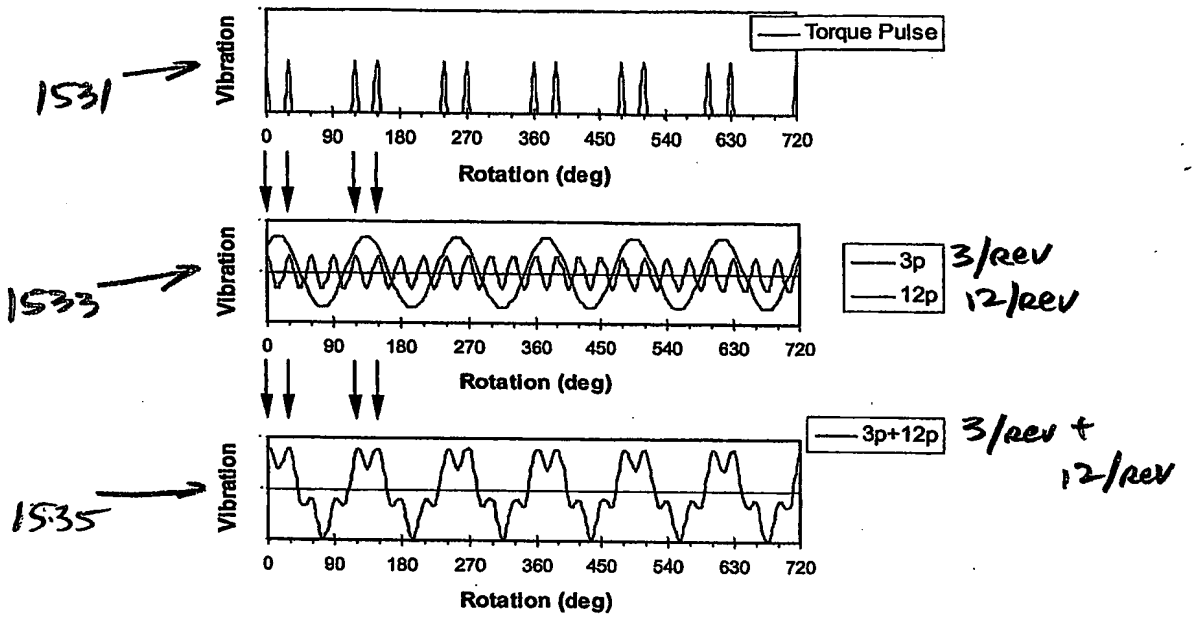

1531
Vibration
Torque Pulse
0 90 180 270 360 450 540 630 720
Rotation (deg)
1533
Vibration
3p
12p
3/rev
12/rev
0 90 180 270 360 450 540 630 720
Rotation (deg)
1535
Vibration
3p+12p
3/rev + 12/rev
0 90 180 270 360 450 540 630 720
Rotation (deg)

Fig 24

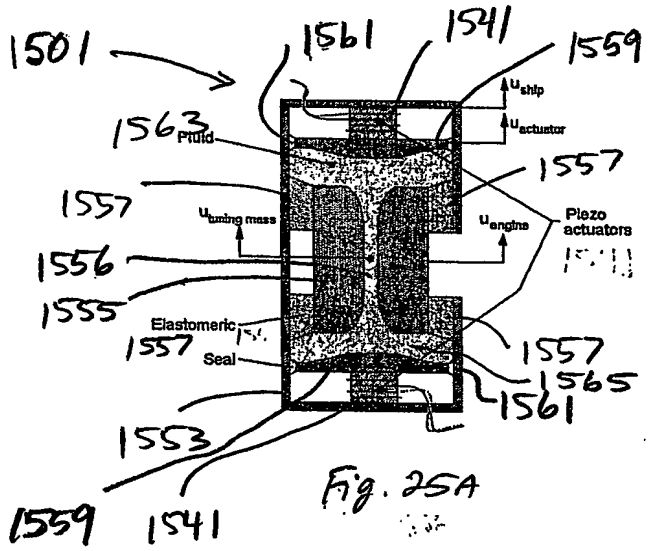


Fig. 25A

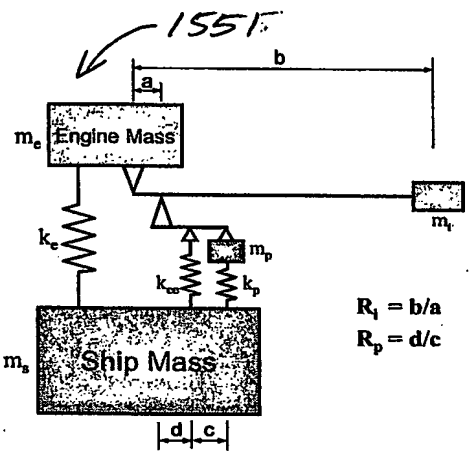


Fig. 25B

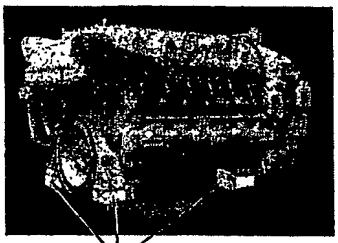


Fig. 26C

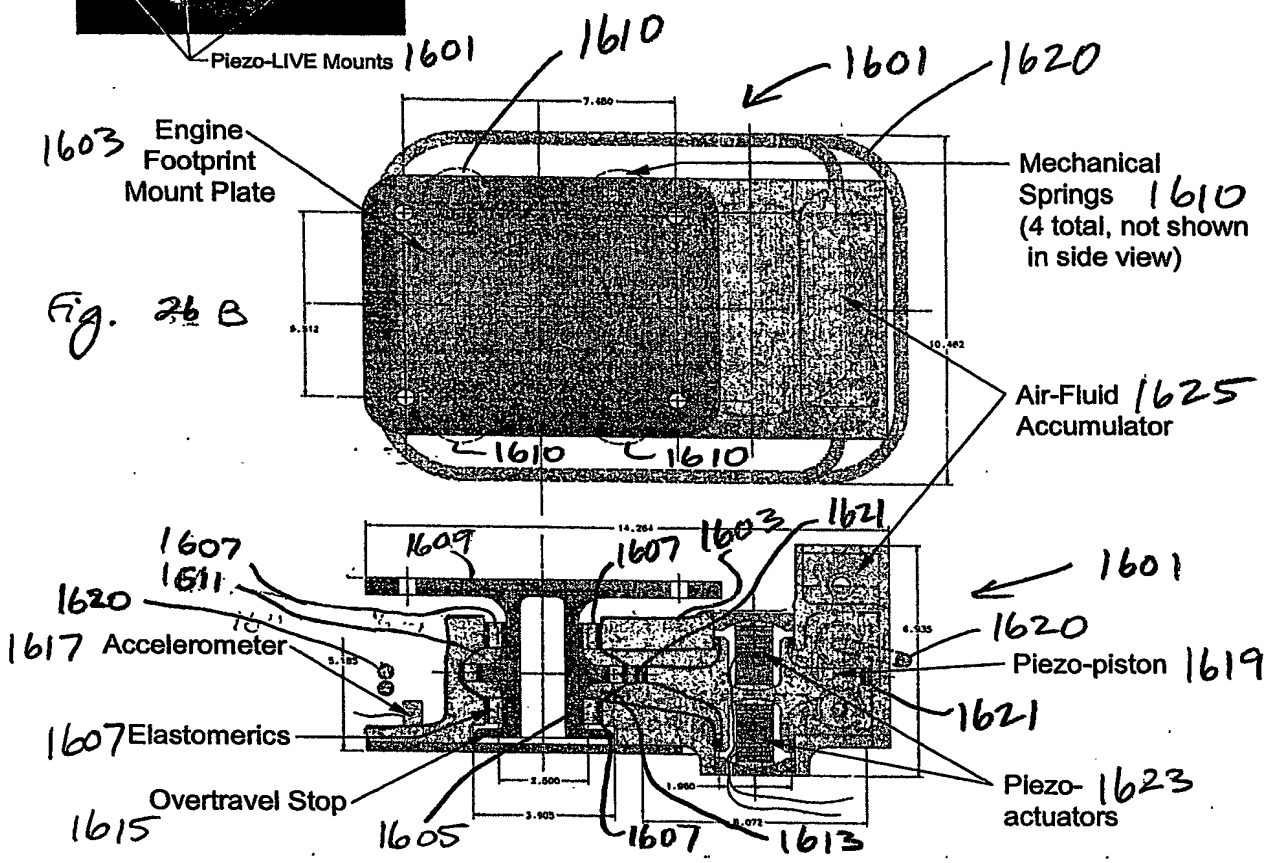
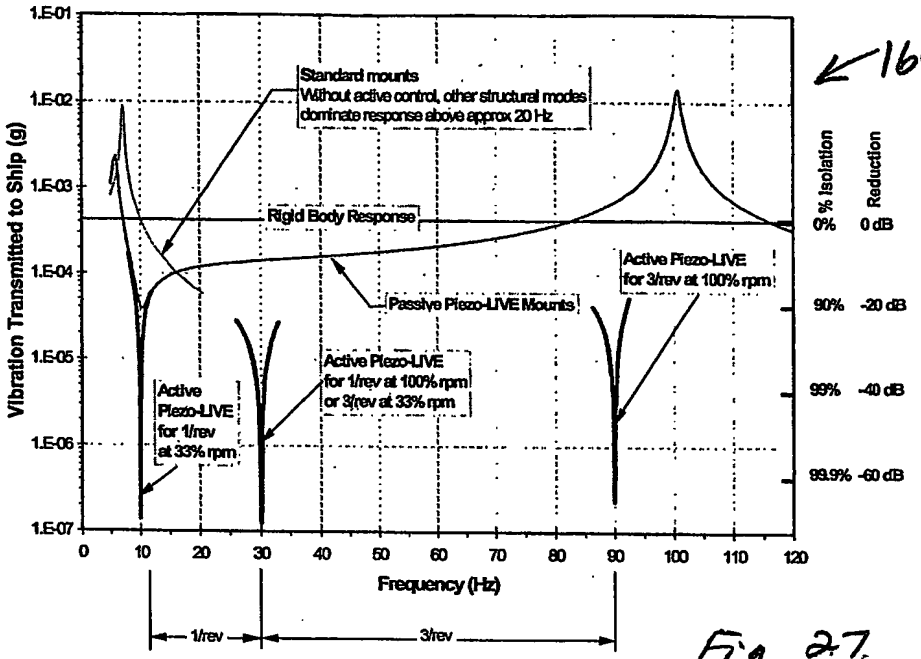


Fig. 26B

Fig 26A


1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Vibration Transmitted to Ship (g)
0
10
20
30
40
50
60
70
80
90
100
110
120
Frequency (Hz)
Standard mounts
Without active control, other structural modes
dominate response above approx 20 Hz
Rigid Body Response
Passive Piezo-LIVE Mounts
Active Piezo-LIVE
for 3/rev at 100% rpm
Active Piezo-LIVE
for 1/rev at 100% rpm
or 3/rev at 33% rpm
Active
Piezo-LIVE
for 1/rev
at 33% rpm
1/rev
3/rev
% Isolation
Reduction
0%
0 dB
90%
-20 dB
99%
-40 dB
99.9%
-60 dB

1645

Fig. 27